

## Plant Species Composition and Cover within Reestablished Broadleaf Marsh

Expectation:	Restoration of a broadleaf marsh community on portions of the floodplain where historic (prechannelization) broadleaf marsh has been drained and replaced by upland and mesophytic communities. In these areas, <i>Sagittaria lancifolia</i> and <i>Pontederia cordata</i> will reestablish as dominant indicator species and account for > 50% of the live plant cover. These and other obligate and facultative wetland species (Reed 1988) will account for > 90% of the cover and > 75% of species composition.
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Relevant Endpoints:	Sociopolitical - Nuisance (Exotic) Species Restoration - Biological Integrity - Community Structure Restoration - Biological Integrity - Colonization Rates Restoration - Biological Integrity - Population Abundance Restoration - System Functional Integrity - Habitat Diversity
Baseline Condition:	As a result of channelization, over 7600 ha (86%) of broadleaf marsh, which dominated vegetation cover on the historic floodplain (Pierce et al. 1982), were drained and converted to cattle pasture and/or has become dominated by upland and mesophytic communities (Milleson et al. 1980).

Baseline plant species composition and cover data were collected in July-October 1998 and 1999 (in three upland herbaceous plots in Pool C and six upland herbaceous plots in Pool A) in 5 m x 20 m permanent plots on portions of the channelized floodplain in Pools A and C where broadleaf marsh communities had existed prior to channelization (or at locations where it is expected to reestablish) but are now covered by: 1) an upland herbaceous (pasture) community, 2) a mesophytic shrub community and 3) a transitional broadleaf marsh/wet prairie community. Three replicate plots also were established on a degraded levee with ground elevations that are expected to be subjected to prolonged hydroperiods consistent with the reestablishment of broadleaf marsh.

Upland herbaceous plots were dominated by pasture grasses (i.e., *Paspalum notatum* and *Cynodon dactylon*). *Sagittaria lancifolia* and *Pontederia cordata* were not present in any of these plots and obligate and facultative wetland species accounted for  $\leq 20\%$  (mean =  $17.2 \pm 0.9\%$  in 1998 and  $15.9 \pm 1.7\%$  in 1999) of the plant cover in each plot in Pool C (n=9 in 1998 and n=3 in 1999), and 6 – 53% (mean =  $30.9 \pm 7.3\%$  in 1998 and  $19.2 \pm 3.6\%$ ) of the plant cover in Pool A plots (n=6)(Table 1). Obligate and facultative wetland species accounted for  $< 70\%$  (mean =  $57.9 \pm 3.4\%$  in 1998 and  $45.8 \pm 4.9\%$  in 1999) of the species composition in Pool C plots, and 27 – 80% (mean =  $59.7 \pm 7.9\%$  in 1998 and  $53.2 \pm 8.4\%$ ) of the species composition in Pool A plots.

The mesophytic shrub sites had a canopy dominated by *Myrica cerifera*, *Baccharis halimifolia*, *Ludwigia peruviana*, *Acer rubrum* and/or *Vitis rotundifolia* and a diverse understory in which both wetland (*Woodwardia virginica*, *Blechnum serrulatum*, *Osmunda regalis*, *Ludwigia peruviana*) and facultative (*Baccharis halimifolia*, *Thelypteris interrupta*, *Myrica cerifera*, *Rubus cuneifolius*, *Vitis rotundifolia*) species were common. *Pontederia cordata* was not present in any of these plots but *Sagittaria lancifolia* was found in seven plots in Pool C (n=12) and all three plots in Pool A where it covered  $\leq 25\%$  of each plot (Table 2). Obligate and facultative wetland species accounted for 26 – 85% (mean =  $60.3 \pm 6.3\%$ ) of the plant cover in Pool C plots and 20 – 43% (mean =  $34.8 \pm 6.7\%$ ) of plant cover in Pool A plots. Obligate and facultative

wetland species accounted for 44 – 80% (mean =  $64.8 \pm 2.4\%$ ) of the species composition in Pool C plots and 42-67% (mean =  $57.7 \pm 7.9\%$ ) of the species composition in Pool A plots.

The transitional broadleaf marsh/wet prairie sites occur in the lower, impounded portions of Pools A and C, where floodplain elevations have remained partially inundated by the controlled water surface elevation, but hydroperiods are shorter and depths are shallower than prior to channelization. Based on midpoints of cover classes of all species in the plot, combined cover of *Pontederia cordata* and *Sagittaria lancifolia* ranged from 5 – 41% of the total plant cover in plots in Pools A (n = 3) and C (n = 3) (Table 3). Obligate and facultative wetland species accounted for > 90% of the total plant cover and > 75% of the species composition in all plots except one (VPC 209) in Pool C.

Plots on the degraded levee had sparse vegetation cover (5-13%) during the summer 1998 baseline sampling period. *Pontederia cordata* and *Sagittaria lancifolia* occurred in one plot but represented < 5% of the live plant cover. Obligate and facultative wetland species accounted for about 33% of the plant cover and species composition in 2 plots and 67% of the cover and composition in the third plot (Table 4).

Reference Condition: Based on photointerpretation of prechannelization aerial photography (Pierce et al. 1982), 8892 ha of historic floodplain was covered by broadleaf marsh, which typically occurred in the central portion of the floodplain where hydroperiods were longest and deepest. There are no quantitative data on plant species composition and cover within historic broadleaf marsh communities of the Kissimmee River. Reference conditions were derived from species composition (Toth 1991) and standing crop biomass (Toth, unpublished) data from transects in remnant broadleaf marshes in the impounded, lower portion of Pool B, where floodplain elevations have been exposed to long (typically  $\geq 250$  da) annual hydroperiods since channelization.

Plant species composition data were collected between 1984-1990 within 1 m<sup>2</sup> quadrats at 7.6 m intervals along three 275-400 m transects. Obligate and facultative wetland species accounted for  $\geq 75\%$  of the species composition in all sample quadrats (n = 351) and all of the species in 83-100% of quadrats per transect per year (Table 5). Only 8 of the 351 quadrat samples had facultative or facultative upland species, although 30 quadrats had 1-2 unidentifiable species. Reference data from these transects (see also Toth, 1991, Toth et al., 1995) indicate species composition of broadleaf marshes of the Kissimmee River floodplain is dominated by obligate and facultative wetland species, which typically include *Sagittaria lancifolia*, *Pontederia cordata*, *Panicum hemitomon*, *Leersia hexandra*, *Sacciolepis striata*, *Alternanthera philoxeroides*, *Nuphar lutea*, *Polygonum punctatum*, *Bacopa caroliniana*, *Hydrocotyle umbellata*, *Cephalanthus occidentalis* and *Ludwigia peruviana*.

Standing crop biomass data were collected in 1990 from ten 0.5 m<sup>2</sup> quadrats equally spaced along two of these transects. *Sagittaria lancifolia*, *Cephalanthus occidentalis* and *Panicum hemitomon* accounted for most (>70%) of the live standing crop and all plant species were either obligate or facultative wetland species (Table 6). *Pontederia cordata* was not dominant along these transects but can be a major component of broadleaf marshes (Pierce et al. 1982, Toth, personal observation). *Sagittaria lancifolia* and/or *Pontederia cordata* accounted for an average of  $29 (\pm 0.07)\%$  and  $42 (\pm 0.05)\%$  of the cumulative standing crop biomass along the two transects.

Although these reference data are indicative of dominant species within broadleaf marsh communities, standing crop biomass is not directly comparable to cover data collected in baseline samples. For example, due to the physiognomy of grasses, standing crop biomass of *P. hemitomon* is not representative of comparable relative cover. Because the distribution of *Cephalanthus* biomass was patchy (e.g., having dominant standing crop

biomass in  $\leq 40\%$  of samples along each transect), its relative cover within these sampled communities was less than indicated by its average or cumulative biomass along the transects. Thus, although these two species are common components of broadleaf marshes they are not expected to reach dominant coverage, and relative cover of the primary indicator species, *Sagittaria lancifolia* and *Pontederia cordata*, is expected to be greater than suggested by their standing crop biomass in reference site samples.

Mechanism for

Achieving Expectation:

Restoration of broadleaf marsh will require reestablishment of historical inundation characteristics, particularly prolonged (9-12 month) hydroperiods. Broadleaf marsh species will reestablish from the vestigial seed bank, nearby remnant propagules or vegetative colonization by adjacent plants. Increased hydroperiods will eliminate upland and mesophytic species.

Adjustments for

External Constraints:

Reestablishment of broadleaf marsh communities could be hindered (possibly precluded) where the exotic climbing fern, *Lygodium microphyllum*, and/or native red maple (*Acer rubrum*) has colonized existing mesophytic shrub habitats.

Means of Evaluation:

Achievement of this expectation will be evaluated by post-restoration sampling of established baseline permanent plots in Pool C, and simultaneous sampling of control plots in Pool A. Plant cover and species composition will be evaluated within these plots annually during August - September. Evaluation of this expectation will be based on reestablishment of all broadleaf marsh criteria (i.e., combined cover of *Pontederia* and *Sagittaria*  $> 50\%$ , and proportional cover ( $> 90\%$ ) and composition ( $> 75\%$ ) of obligate and facultative wetland species) in each plot in Pool C. As during baseline sampling, cover of each plant species will be estimated using modified Daubenmire cover classes (Table 7); however, more precise estimates of *Pontederia* and *Sagittaria* cover will be made if combined cover classes of these species approximate 50%. Because the spatial (i.e., elevation) distribution of wetland shrub communities was similar to that of broadleaf marsh on the historic floodplain, and wetland shrub species exist in some baseline plots (i.e., mesophytic shrub plots), evaluation of achievement of this expectation will exclude any plots where wetland shrub communities (per Bousquin et al. 2001) reestablish.

Time Course:

Based on responses to floodplain inundation experiments such as the demonstration project (Toth 1991) broadleaf marsh species are expected to begin to colonize during the first year after hydrologic regimes are reestablished. All criteria for this expectation will be achieved within 3 years after reestablishment of prechannelization hydroperiods on portions of the floodplain that are presently covered by improved pasture communities. In floodplain areas with existing mesophytic shrub communities, reestablishment of the broadleaf marsh species composition and cover may take up to 5 years, as mesophytic shrub species can withstand some inundation (Toth et al. 1998). The time period for this expected response will be delayed if dryer than normal climatic conditions lead to shorter hydroperiods.

Table 1. Baseline plant species composition and cover in upland herbaceous (pasture) plots (5 m x 20 m) in Pools A and C. Baseline sampling of plots #174, 176, 182, 178, 179, 180 ended in 1998 because hydroperiods were affected by Phase I reconstruction prior to the 1999 sampling period.

Plot	% <i>Pontederia</i> <i>Sagittaria</i>				% Cover of Obligate and Facultative Wetland Species		% of Obligate and Facultative Wetland Species	
<u>Pool A</u>	<u>'98</u>	<u>'99</u>	<u>'98</u>	<u>'99</u>	<u>1998</u>	<u>1999</u>	<u>1998</u>	<u>1999</u>
400	0	0	0	0	11.2	6.1	37	27
401	0	0	0	0	9.7	10.3	38	50
402	0	0	0	0	26.6	23.5	53	43
419	0	0	0	0	43.4	22.6	71	60
420	0	0	0	0	41.7	27.3	79	78
422	0	0	0	0	52.8	25.5	80	67
Pool C								
108	0	0	0	0	20.3	19.1	63	63
110	0	0	0	0	11.7	15.6	46	44
111	0	0	0	0	14.5	13.1	36	29
174	0	0	0	0	16.9	-	60	-
176	0	0	0	0	19.1	-	64	-
182	0	0	0	0	17.0	-	57	-
178	0	0	0	0	16.8	-	62	-
179	0	0	0	0	18.5	-	64	-
180	0	0	0	0	20.2	-	69	-

Table 2. Baseline plant species composition and cover in mesophytic shrub plots (5 m x 20 m) in Pools A and C.

Plots	% <i>Pontederia</i> <i>Sagittaria</i>		% Cover of Obligate and Facultative Wetland Species	% of Obligate and Facultative Wetland Species
Pool A				
451	0	< 5	42.1	42
453	0	< 5	19.8	67
455	0	< 5	42.9	64
Pool C				
163	0	< 5	45.0	68
165	0	0	39.3	44
166	0	0	79.1	68
185	0	< 5	62.1	67
189	0	< 5	64.5	72
212	0	< 5	71.6	67
217	0	0	59.4	63
218	0	0	25.8	62
348	0	0	41.2	58
169	0	6 – 25	65.7	65
171	0	< 5	84.9	80
172	0	6 – 25	59.4	63

Table 3. Baseline plant species composition and cover in transitional broadleaf marsh/wet prairie plots (5 m x 20 m) in Pools A and C. Combined proportional cover of *Pontederia* and *Sagittaria* is based on midpoints of cover classes of all species in the plot.

Plots	% <i>Pontederia</i> <i>Sagittaria</i> (Combined)			% Cover of Obligate and Facultative Wetland Species	% of Obligate and Facultative Wetland Species
Pool A					
425	6 – 25	6 – 25	23.8	100	100
426	6 – 25	6 – 25	33.7	97.3	94
427	6 – 25	26 – 50	41.3	98.1	96
Pool C					
207	< 5	26 – 50	28.2	93.0	78
208	< 5	6 – 25	13.0	94.6	86
209	< 5	< 5	4.7	85.8	67

Table 4. Baseline plant species composition and cover in degraded levee plots (5 m x 20 m) in Pool C.

Plots	% <i>Pontederia</i> <i>Sagittaria</i>		% Cover of Obligate and Facultative Wetland Species	% of Obligate and Facultative Wetland Species
Pool C				
350	0	0	31	31
351	<5	<5	67	67
352	0	0	33	33

Table 5. Reference conditions for relative proportion of obligate and facultative wetland species in broadleaf marsh. Data were collected within 1 m<sup>2</sup> quadrats along remnant broadleaf marsh transects (DRN, DRS and TT) in the lower portion of Pool B.

Transect	Year	N	% of Quadrats with only Obligate and Facultative Wetland Species	Lowest Proportion (% per quadrat) of Obligate and Facultative Wetland Species
DRN	1984	37	87	83
DRS	1984	37	84	78
DRS	1990	37	92	83
TT	1984	48	83	80
TT	1986	48	88	75
TT	1987	48	92	75
TT	1988	48	100	100
TT	1990	48	92	80

Table 6. Reference conditions for relative cover of plant species within broadleaf marshes. Relative (% of total biomass) standing crop of plant species found within ten 0.5 m<sup>2</sup> samples along remnant broadleaf marsh transects (DRS and TT) in lower Pool B.

Plant Species	DRS	TT
<i>Alternanthera philoxeroides</i>	0.1	1.6
<i>Bacopa caroliniana</i>	1.3	0.0
<i>Cephalanthus occidentalis</i>	20.4	24.3
<i>Eleocharis interstincta</i>	0.4	0.3
<i>Ipomoea sagittata</i>	< 0.1	0.0
<i>Leersia hexandra</i>	2.5	< 0.1
<i>Ludwigia peruviana</i>	< 0.1	4.3
<i>Luziola fluitans</i>	< 0.1	0.0
<i>Nuphar lutea</i>	0.0	0.2
<i>Panicum hemitomon</i>	20.0	25.2
<i>Polygonum punctatum</i>	2.4	12.5
<i>Pontederia cordata</i>	8.7	0.3
<i>Rhynchospora inundata</i>	0.4	0.0
<i>Sacciolepis striata</i>	13.5	0.2
<i>Sagittaria lancifolia</i>	29.7	25.3
<i>Salvinia minima</i>	0.5	0.0
<i>Sarcostemma clausum</i>	0.1	4.8
<i>Scirpus californicus</i>	0.0	1.2

Table 7. Modified Daubenmire scale used for differentiating cover classes of plant species within plots.

Cover Class	% Cover
1	1 – 5
2	6 – 25
3	26 – 50
4	51 – 75
5	76 – 95
6	> 95

## References

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